(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(54) Title: PRIORITIZED SENDING OF DATA

(57) Abstract: According to the present invention, a method and a system for communicating data in a telecommunication network (3) in which the available capacity is not uniformly distributed is disclosed. The system comprises control means (2) for tracking the locations of a mobile station (1) moving in the telecommunication network (3), and for scheduling the data communication to or from the mobile station in accordance with the current capacity of the network and the predicted future capacity.
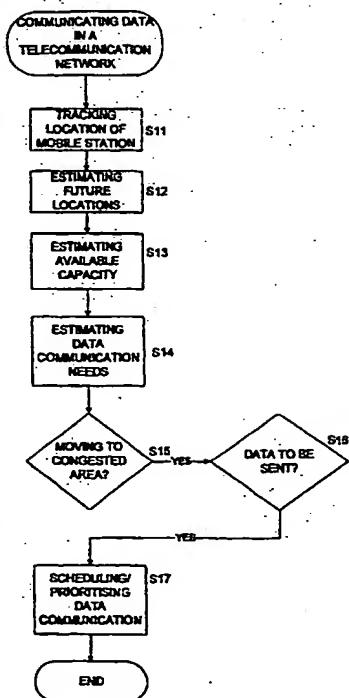
TITLE OF THE INVENTION

Prioritized sending of data.

FIELD OF THE INVENTION

The present invention relates to a method and a system for communicating data in a cellular telecommunication network.

BACKGROUND OF THE INVENTION

According to cellular network systems, the entire area of coverage is divided into contiguous or overlapping cells having a size up to several kilometers depending on the anticipated traffic load. Each cell comprises a base station with a certain communication capacity or throughput capacity. Neighbouring cells use different frequencies, although cells that are further apart can use the same frequencies as they are not hindered by each other due to the relatively low power of all the transmitting stations used. Alternatively, some radio technologies like CDMA (Code Division Multiple Access) systems can use the same frequency in neighbouring or overlapping cells.

Different types of cells can be handled in the same geographical environment in a limited bandwidth. For example, there may be two different overlapping cell layers in one geographical region, which layers consist of micro cells and macro cells, respectively.

When a mobile station (MS) moves in such a cellular network while communicating via this network, handovers between cells in an area of the network have to take place. Moreover, while moving in the cellular network, the mobile station may move to a congested area consisting of at least one congested

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cell. In congested areas, however, the Quality of Service
(QoS) offered to the mobile station may have to be reduced.

SUMMARY OF THE INVENTION

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It is therefore an object of the present invention to enable
reliable and optimized data communication in
telecommunication networks having congested areas.

10 According to a first aspect of the present invention, this
object is achieved by a method for communicating data in a
telecommunication network in which the available capacity is
not uniformly distributed, comprising the steps of:
      tracking the locations of a mobile station moving in the
15 telecommunication network; and
      scheduling the data communication to or from the mobile
station in accordance with the available capacity of the
network.

20 According to a second aspect of the present invention, the
above-mentioned object is achieved by a telecommunication
system for communicating data in a telecommunication network
in which the available capacity is not uniformly distributed,
comprising:
25   control means for tracking the locations of a mobile
station moving in the telecommunication network, and for
scheduling the data communication to or from the mobile
station in accordance with the available capacity of the
network.
30

The scheduling can be performed on the basis of the available
capacity of the network at the current location and/or future
locations of the mobile station

35 The control means may estimate the future locations of the
mobile station on the basis of the tracked locations.

Furthermore, the control means may estimate the future
locations of the mobile station on the basis of route
information about the moving mobile station provided by the
5   mobile station.

The future locations of the mobile station can also be
estimated on the basis of movement patterns of the mobile
station.
10

Moreover, the control means may estimate the available
capacity of the network at the current and future locations
of the mobile station on the basis of an estimated current
and/or future traffic load distribution of the network in the
15   area in which and/or towards the mobile station is moving.

The area may comprise cells, groups of cells, geographical
areas and network nodes.

20   In addition, the control means estimate the data
communication needs of the mobile station.

The data communication to or from the mobile station may be
prioritized by the control means when the data communication
25   needs exceed a specific amount of data to be communicated.

Moreover, the data communication to or from the mobile
station at the current location of the mobile station may be
prioritized by the control means when the available capacity
30   at future locations is less than that at the current
location.

In contrast thereto, the data communication to or from the
mobile station at the current location of the mobile station
35   may be delayed by the control means when the available

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capacity at future locations is higher than that at the
current location.

The mobile station may execute measurements of the traffic
5 load distribution in the area and along the path in which it
is moving, wherein the control means estimate the available
capacity of the current and future locations of the mobile
station on the basis of the measurement results transmitted
from the mobile station to the control means.
10

Furthermore, the control means may monitor buffers for
buffering data transmitted to and from the mobile station,
and estimate the data communication needs of the mobile
station on the basis of the monitored amount of buffered
15 data.

The control means may also estimate the data communication
needs of the mobile station on the basis of a transmission
request from the mobile station.
20

The mobile station may execute the measurements according to
traffic load distribution information received from the
network.

25 In addition, a plurality of mobile stations each having data
communication needs may be present in the network, wherein
the data communications of the plurality of mobile stations
are scheduled in accordance with the available capacity of
the network.
30

The data communications of the plurality of mobile stations
can also be scheduled in accordance with estimated data
communication needs of these mobile stations.

35 According to the present invention, the Quality of Service
provided for a mobile station communicating a significant

amount of data can be maintained even if the mobile station moves in a network in which the available capacity is not uniformly distributed.

5 Furthermore, according to the present invention, network resources and radio efficiency can be optimized.

Moreover, according to the present invention, network capacities can be reserved for the users.

10

In the following the present invention will be described by way of a preferred embodiment thereof with reference to the accompanying drawings.

15 BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 shows a schematic block diagram of a communication system according to an embodiment of the present invention.

20 Fig. 2 shows a flow chart of an operation of control means according to the embodiment of the present invention.

Fig. 3 shows a flow chart of a more detailed operation of the control means according to the present invention.

25

DESCRIPTION OF THE PREFERRED EMBODIMENT

Fig. 1 shows a schematic block diagram of a communication system according to an embodiment of the present invention.
30 As it is illustrated in Fig. 1, a mobile station 1 is connected to a network 3, and control means 2 communicate with the mobile station 1 and the network 3.

In Fig. 1, the control means 2 are shown as being located
35 between the mobile station 1 and the network 3. However, the control means can also be partially or fully included in the

network 3. Moreover, parts of the control means also can be
incorporated in the mobile station 1.

The network 3 may be a cellular network formed of contiguous
5   or overlapping cells, in which the available capacity is not
uniformly distributed. There may be cells of different sizes,
each grouped in layers, for example a macro layer consisting
of macro cells and a micro layer consisting of micro cells
within a macro cell.
10

When the mobile station 1 moves in the network, the cell that
is serving the mobile station may change.

Moreover, when the mobile station 1 encounters a congested
15 area in the network 3 which is formed of at least one cell
having a traffic load which is expected to be above a
predetermined threshold, the Quality of Service (QoS)
provided for the mobile station 1 may have to be reduced.

20 It is noted, that an area in the network can comprise cells,
groups of cells, geographical areas or network nodes.

In case data communication has to be performed by the mobile
station 1 via the network 3 while the mobile station 1 is
25 moving in the network having non-uniformly distributed
available capacity, measures have to be taken in order to
provide a reliable and optimized data transmission and
reception by the mobile station 1.

30 According to the present invention, the control means 2
operate to provide a reliable and optimized data
communication in the network 3. The operation of the control
means 2 will be described in the following with respect to
the flow charts shown in Figs. 2 and 3.
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According to the embodiment of the present invention shown in
Fig. 2, the control means 2 keep track of the locations of
the mobile station 1 moving in the network 3 (step S1). In
case the control means 2 estimate that the mobile station is
5   going to move to or enter a congested area in the network 3
(step S2), i.e. an area where the available capacity is
decreased, and that there are data to be sent or received by
the mobile station (step S3) the control means 3 prioritize
the data communication to or from the mobile station 1 (step
10 S4).

Alternatively, if the control means estimate that the mobile
station is going to move to a less congested area it delays
the data transmission or reception of the mobile station.

15

Fig. 3 shows a more detailed operation of the control means.
According to Fig. 3, the control means 2 keep track of the
locations of the mobile station 1 as it moves in the network
3 (step S11). In other words, the control means 2 always can
20 estimate the location of the mobile station 1. In addition,
the control means 2 estimate the moving direction or future
locations and/or the velocity of the mobile station (step
S12) on the basis of the tracked locations. Moreover, the
future locations of the mobile station 1 can also be
25 estimated on the basis of route information stored in the
network 3. The route information comprises map information
such as the road on which a user operating the mobile station
is traveling or information about movement patterns of users
or this specific user. In addition, the mobile station may be
30 able to inform the network 3 or the control means 2 about its
movement pattern either automatically or the subscriber will
decide when the procedure will be started.

The control means 2 estimate the traffic load distribution in
35 the vicinity of the mobile station and/or along the path on
which the mobile station is moving (step S13). This can be

done for example by evaluating a traffic load distribution
present in the network 3. Furthermore, the mobile station 1
can execute measurements of the traffic load distribution in
its vicinity and can inform the control means 2 about these
5 measurements. The mobile station 1 can perform these
measurements on the basis of traffic load distribution
information provided by the network 3. Then, the control
means 2 can use these measurements for estimating the
available capacity of the network in the vicinity of the
10 actual location of the mobile station.

The traffic load distribution can for example be measured on
a cell-to-cell basis.

15 Furthermore, the control means 2 estimate data communication
needs offered by the mobile station 1 (step S14). This
estimation is made by checking buffers for buffering data
transmitted to or from the mobile station 1 or by checking
whether the mobile station 1 has indicated data communication
20 needs. The estimation also can be based on previous data
communication requirements or previous data communications
and type of connection of the mobile station.

When the control means 2 estimate on the basis of the
25 estimated moving direction or future locations and/or
velocity of the mobile station 1 and on the basis of the
estimated traffic load of a neighboring area that it is very
likely that the mobile station 1 is moving towards or enters
a congested area (step S15), and when the control means
30 estimate that there are data communication needs of the
mobile station, i.e. that the mobile station will transmit or
receive data very soon (step S16), by detecting the state of
buffers in the control means or an indicated data
communication need, the control means 2 schedule the traffic
35 to or from the mobile station 1 by giving the traffic to or
from the mobile station 1 a priority, while the mobile

station 1 is still in a less congested area of the network 3
(step S17).

The control means 2 can also instruct the mobile station 1 to
perform the data communication quickly before entering the
congested area.

Alternatively, the control means 2 can delay the data
communication to or from the mobile station 1 in case it
estimates that the mobile station 1 is going to enter a less
congested area, i.e. an area having more capacity available
than that area in which the mobile station is currently
present.

The priority given to the mobile station 1 by the control
means 2 may for example depend on the mobile or connection
class of the mobile station 1 or the type of subscription.

The control means 2 are able to estimate a probability with
which or when the mobile station is going to enter a
congested area. That is, the control means 2 can estimate a
probability with respect to movements of a subscriber.
Moreover, the control means 2 are able to estimate relative
or absolute changes in the available capacity, i.e. a
probability of congestion in the network 3. If the estimated
probability with respect to the movement of the subscriber or
mobile station 1 exceeds a predetermined threshold and/or the
relative or absolute change in the available capacity exceeds
a threshold, the control means 2 may prioritize the data
communication to or from the mobile station 1. These
thresholds may be fixed or dynamic thresholds and may for
example depend on network conditions. For example, the
thresholds may be set in accordance with relative or absolute
changes of the available capacity.

For example, according to a GPRS (General Packet Radio
Service) network system, the control means 2 combine the
features of a Serving GPRS Support Node (SGSN) and a Base
Station Controller (BSC).

5

According to this example, the mobile station 1 connects to
the network 3 via a Base Station System (BSS) comprising the
BSC, which communicates with the SGSN.

10 The SGSN is able to track the location of the mobile station
1. The BSC which comprises buffers for buffering data
transmitted to or from the mobile station 1 is able to
estimate data communication needs of the mobile station 1 by
monitoring filling conditions of its buffers. Moreover, the
15 mobile station 1 executes measurements of neighbouring cells
and the BSC can derive from these measurements whether the
mobile station 1 is close to a congested cell or area. The
BSC communicates the information about the data communication
needs of the mobile station 1 and the moving direction and/or
20 velocity of the mobile station 1 to the SGSN which knows the
Quality of Service provided for the mobile station 1 and is
able to prioritize or schedule the traffic to or from the
mobile station 1.

25 The present invention is also applicable in the field of High
Speed Circuit Switched Data (HSCSD) systems, UMTS (Universal
Mobile Telecommunications System), BRAN (Broadband Radio
Access Networks) and satellite communication systems.

30 In particular, the present invention is applicable to systems
in which the user is stationary and is subjected to network
location and capacity changes.

According to the present invention, the Quality of Service
35 provided for a mobile station communicating a significant
amount of data can be maintained even if the mobile station

moves in a network in which the available capacity is not
uniformly distributed.

Furthermore, according to the present invention, network
5 resources and radio efficiency can be optimized.

While the invention has been described with reference to a
preferred embodiment, the description is illustrative of the
invention and is not to be construed as limiting the
10 invention. Various modifications and applications may occur
to those skilled in the art without departing from the true
spirit and scope of the invention as defined by the appended
claims.

CLAIMS:

1. A method for communicating data in a telecommunication
network (3) in which the available capacity is not uniformly
5   distributed, comprising the steps of:
        tracking (S1) the locations of a mobile station (1)
moving in the telecommunication network (3); and
        scheduling (S4) the data communication to or from the
mobile station (1) in accordance with the available capacity
10 of the network.

2. The method according to claim 1, wherein the data
communication to or from the mobile station is scheduled in
accordance with the available capacity of the network at the
15 current and/or future locations of the mobile station.

3. The method according to claim 2, comprising the further
step of:
        estimating (S12) the future locations of the mobile
20 station on the basis of the locations tracked in the tracking
step (S1).

4. The method according to claim 2, comprising the further
step of:
25   estimating (S12) the future locations of the mobile
station on the basis of route information about the moving
mobile station provided by the mobile station.

5. The method according to claim 2, comprising the further
30 step of:
        estimating (S12) the future locations of the mobile
station on the basis of movement patterns of the mobile
station.

35 6. The method according to claim 2, comprising the further
step of:

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estimating (S13) the available capacity of the network at the current and future locations of the mobile station on the basis of an estimated current and/or future traffic load distribution of the network in the area in which and/or

5   towards the mobile station is moving.

7. The method according to claim 6, wherein the area comprises cells, groups of cells, geographical areas and network nodes.

10

8. The method according to claim 1, comprising the further step of:
    estimating (S3) the data communication needs of the mobile station.

15

9. The method according to claim 8, wherein the data communication to or from the mobile station is prioritized in the scheduling step when the data communication needs exceed a specific amount of data to be communicated.

20

10. The method according to claim 2, wherein the data communication to or from the mobile station at the current location of the mobile station is prioritized in the scheduling step when the available capacity at future

25 locations is less than that at the current location.

11. The method according to claim 2, wherein the data communication to or from the mobile station at the current location of the mobile station is delayed in the scheduling

30 step when the available capacity at future locations is higher than that at the current location.

12. The method according to claim 6, wherein the mobile station executes measurements of the traffic load

35 distribution in the area and along the path in which it is moving, and wherein the available capacity of the current and

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future locations of the mobile station is estimated on the
basis of the measurement results.

13. The method according to claim 8, comprising the further
5   step of:
        buffering data transmitted to and from the mobile
station (1), wherein the estimation of the data communication
needs of the mobile station (1) is performed by monitoring
the amount of buffered data.
10

14. The method according to claim 8, wherein the data
communication needs of the mobile station are estimated on
the basis of a transmission request from the mobile station.

15   15. The method according to claim 12, wherein the mobile
station executes the measurements according to traffic load
distribution information received from the network.

16. The method according to claim 1, wherein a plurality of
20   mobile stations each having data communication needs are
present in the network, and wherein the data communications
of the plurality of mobile stations are scheduled in
accordance with the available capacity of the network.

25   17. The method according to claim 16, wherein the data
communications of the plurality of mobile stations are
scheduled in accordance with estimated data communication
needs of these mobile stations.

30   18. A telecommunication system for communicating data in a
telecommunication network (3) in which the available capacity
is not uniformly distributed, comprising:
        control means (2) for tracking the locations of a mobile
station (1) moving in the telecommunication network (3), and
35   for scheduling the data communication to or from the mobile

station in accordance with the available capacity of the
network.

19. The system according to claim 18, wherein the control
5   means schedules the data communication to or from the mobile
station in accordance with the available capacity of the
network at the current and/or future locations of the mobile
station.

10   20. The system according to claim 19, wherein the control
means estimate the future locations of the mobile station on
the basis of the tracked locations.

21. The system according to claim 19, wherein the control
15   means estimate the future locations of the mobile station on
the basis of route information about the moving mobile
station provided by the mobile station.

22. The system according to claim 19, wherein the control
20   means estimate the future locations of the mobile station on
the basis of movement patterns of the mobile station.

23. The system according to claim 19, wherein the control
means estimate the available capacity of the network at the
25   current and future locations of the mobile station on the
basis of an estimated current and/or future traffic load
distribution of the network in the area in which and/or
towards the mobile station is moving.

30   24. The system according to claim 23, wherein the area
comprises cells, groups of cells, geographical areas and
network nodes.

25. The system according to claim 18, wherein the control
35   means estimate the data communication needs of the mobile
station.

26. The system according to claim 25, wherein the data communication to or from the mobile station is prioritized by the control means when the data communication needs exceed a

5   specific amount of data to be communicated.

27. The system according to claim 19, wherein the data communication to or from the mobile station at the current location of the mobile station is prioritized by the control

10 means when the available capacity at future locations is less than that at the current location.

28. The system according to claim 19, wherein the data communication to or from the mobile station at the current

15 location of the mobile station is delayed by the control means when the available capacity at future locations is higher than that at the current location.

29. The system according to claim 23, wherein the mobile

20 station executes measurements of the traffic load distribution in the area and along the path in which it is moving, and wherein the control means estimate the available capacity of the current and future locations of the mobile station on the basis of the measurement results transmitted

25 from the mobile station to the control means.

30. The system according to claim 25, wherein the control means monitor buffers for buffering data transmitted to and from the mobile station (1), and estimate the data

30 communication needs of the mobile station (1) on the basis of the monitored amount of buffered data.

31. The system according to claim 25, wherein the control means estimate the data communication needs of the mobile

35 station on the basis of a transmission request from the mobile station.

32. The system according to claim 29, wherein the mobile
station executes the measurements according to traffic load
distribution information received from the network.

5

33. The system according to claim 18, wherein a plurality of
mobile stations each having data communication needs are
present in the network, and wherein the data communications
of the plurality of mobile stations are scheduled in
10 accordance with the available capacity of the network.

34. The system according to claim 33, wherein the data
communications of the plurality of mobile stations are
scheduled in accordance with estimated data communication
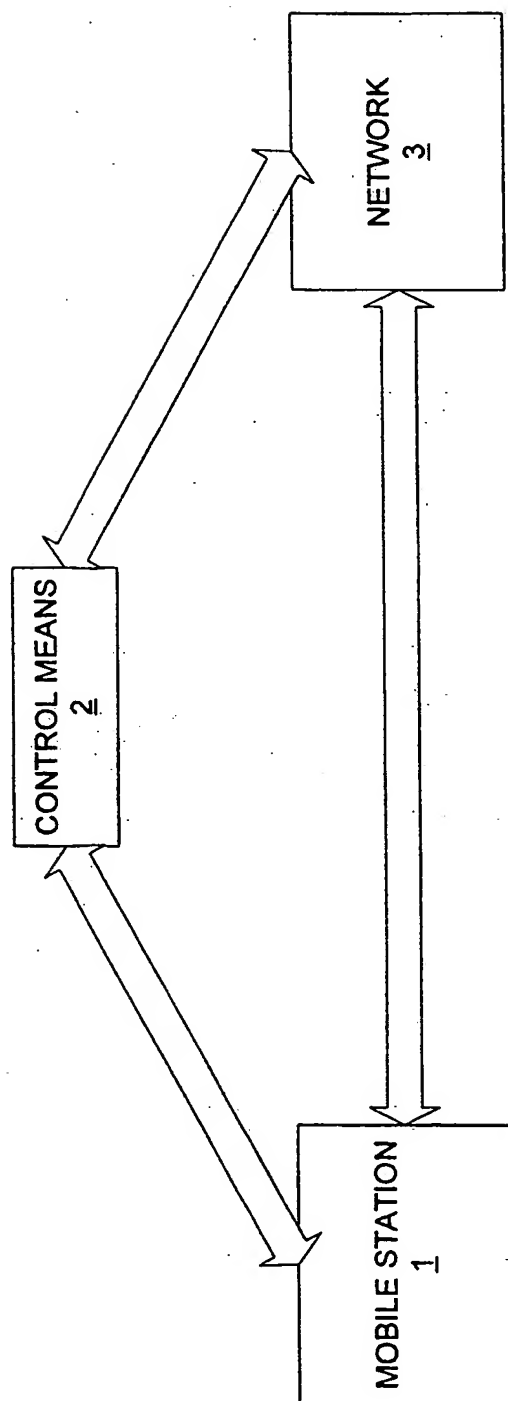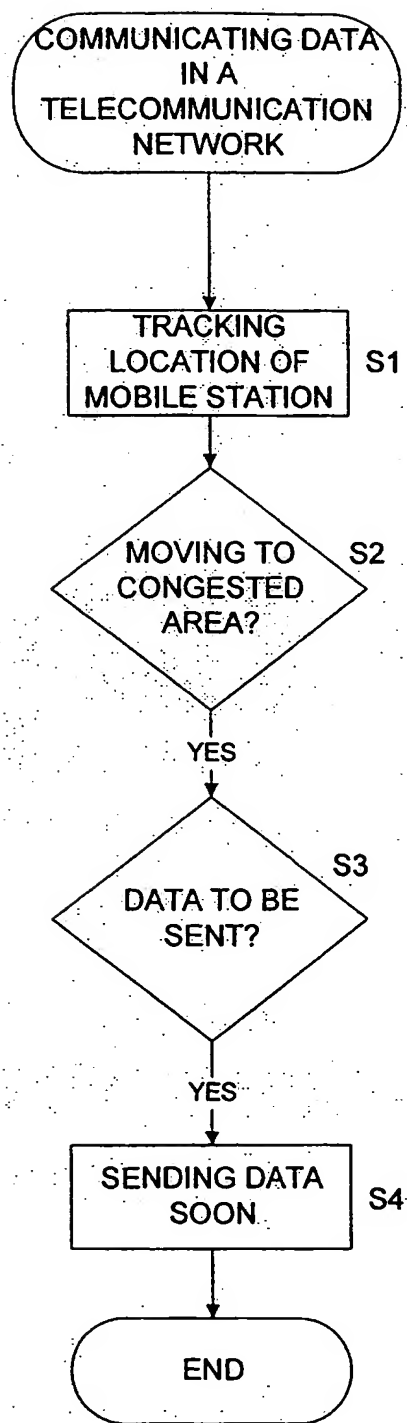15 needs of these mobile stations.

FIG. 1

FIG. 2

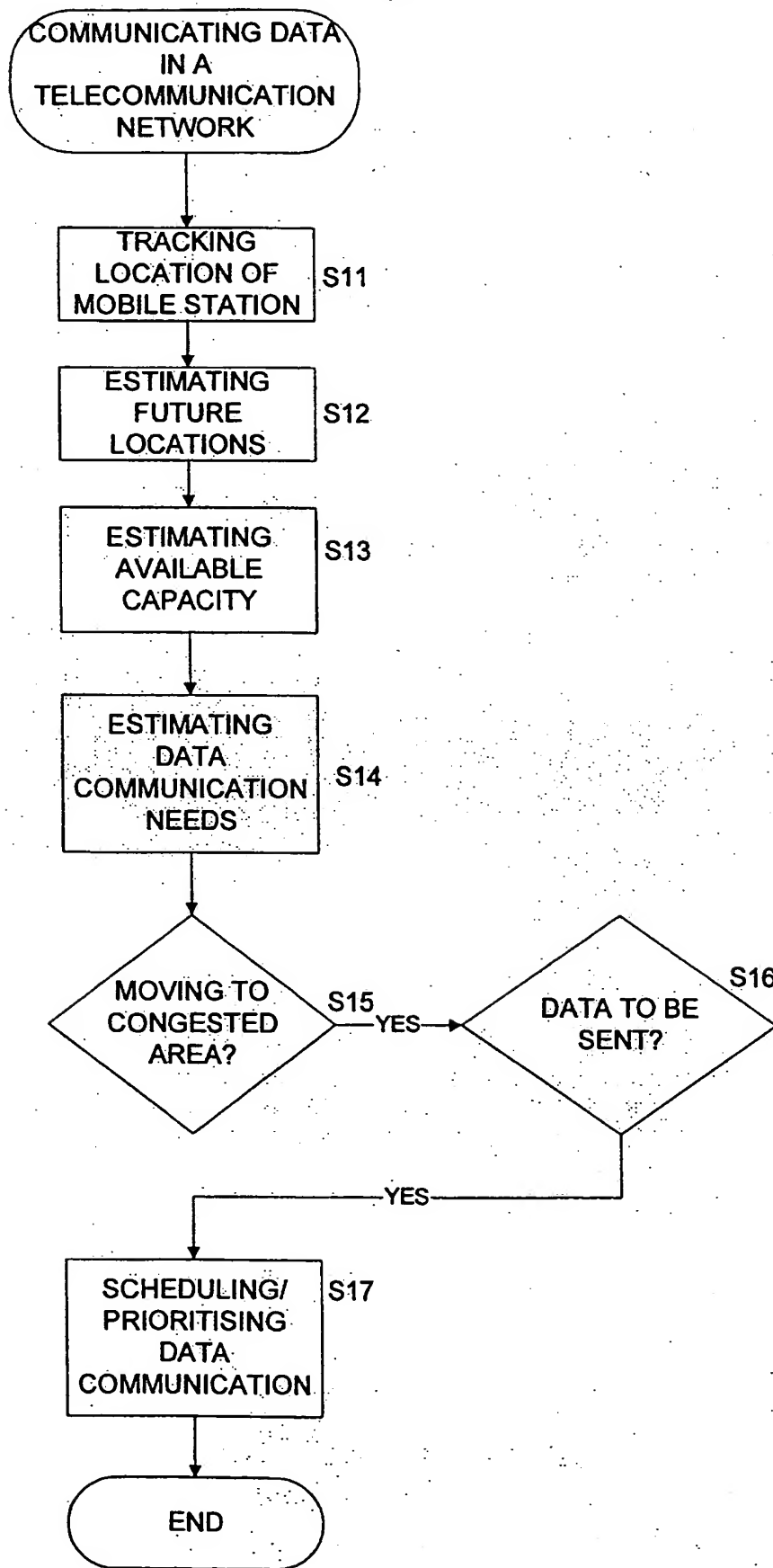FIG. 3

INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H04Q7/38

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 H04Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category°	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 98 35514 A (QUALCOMM INC) 13 August 1998 (1998-08-13)	1,2,8,9, 13,14, 16-19, 25,26, 30,31, 33,34
	page 6, line 4 -page 8, line 2 page 11, line 37 -page 14, line 2 page 15, line 35 -page 18, line 8 page 53, line 1 -page 55, line 31	
A	WO 98 45966 A (QUALCOMM INC) 15 October 1998 (1998-10-15)	

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance
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"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
7 March 2000	14/03/2000

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Bocking, P

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

Information on patent family members

Patent document cited in search report	Publication date	Patent family member(s)		Publication date
WO 9835514 A	13-08-1998	AU	6276298 A	26-08-1998
		BR	9806115 A	31-08-1999
		CA	2251397 A	13-08-1998
		EP	0897644 A	24-02-1999
WO 9845966 A	15-10-1998	US	5914950 A	22-06-1999
		AU	7246698 A	30-10-1998
		EP	0974237 A	26-01-2000
		US	5923650 A	13-07-1999
		ZA	9802973 A	13-10-1998